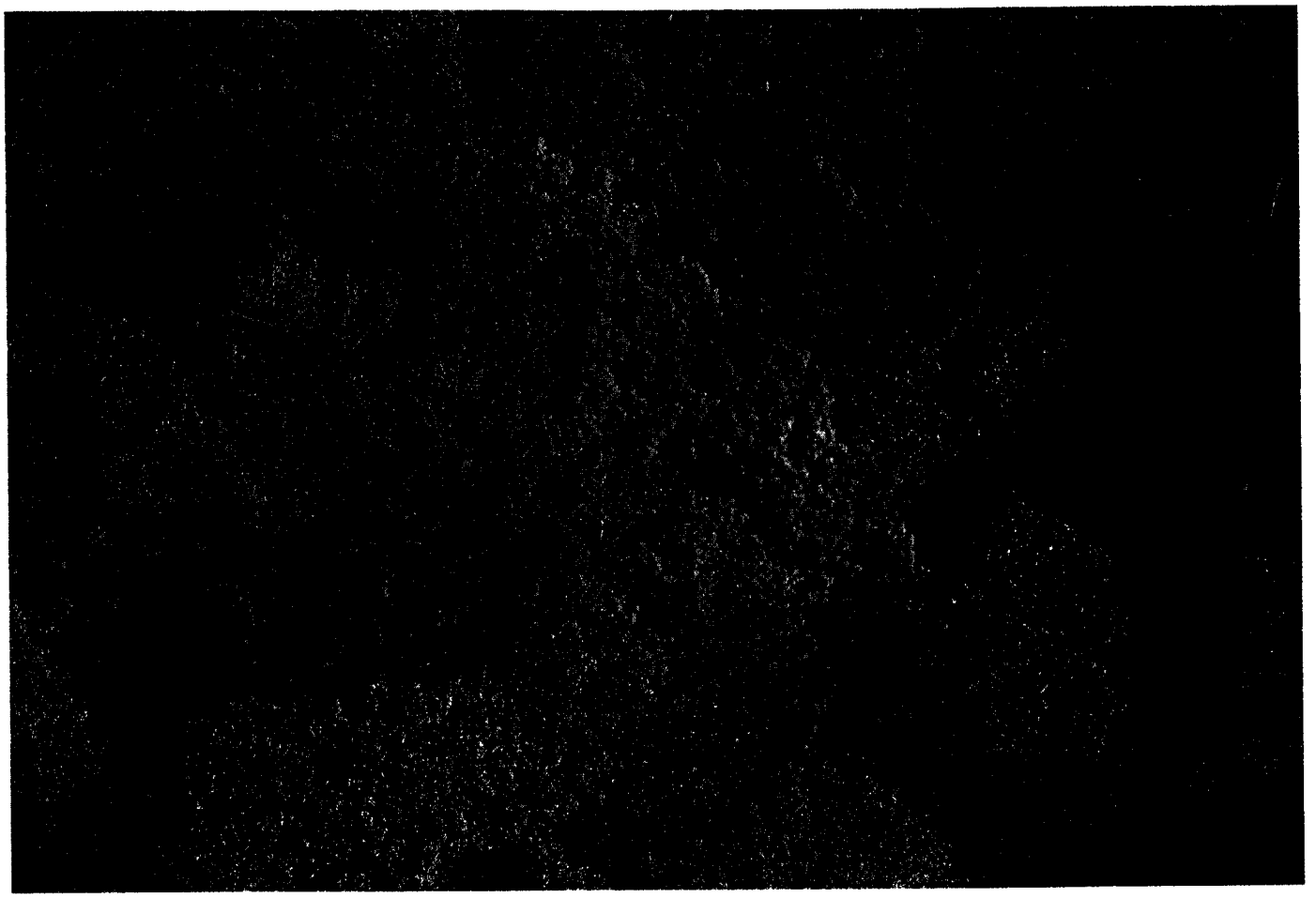


Aerial view of southern pine beetle infestations.

Naturally occurring compound can protect pines from the southern pine beetle

B.L. Strom, R.A. Goyer, and J.L. Hayes,[1]

The naturally occurring compound, 4-AA, found at low levels in plant resin, is being developed through collaborative research to protect high value pines from southern pine beetle attacks.

The southern pine beetle (SPB), *Dendroctonus frontalis*, is the most destructive insect pest of southern pine forests. This tiny insect, smaller than a grain of rice, is responsible for killing pine timber worth millions of dollars on a periodic basis in Louisiana.

Outbreaks in 1985-1986, 1991-1993, and again in 1995 have created massive disruption of normal harvest cycles, forcing small and large area landowners to salvage infested timber at reduced value to prevent the spread of this tree killer. As many as eight generations, or life cycles, of SPB occur in a single calendar year in the Deep South leading to rapid population explosions.

Although lightning-struck, weakened, overcrowded, or moisture-stressed trees may harbor initial outbreaks, the SPB can aggressively attack nearby

[1] Graduate Research Assistant (Entomology) and Entomologist, USDA Forest Service, Pineville, LA; professor, Department of Entomology, Agricultural Experiment Station, LSU Agricultural Center, Baton Rouge, LA 70803; and adjunct associate professor (Entomology) and Project Leader, USDA Forest Service, Pineville, LA.

healthy pines leading to the equivalent of an entomological forest fire that can spread indefinitely if not controlled by nature or human intervention. Control tactics in a forest setting usually involve felling beetle-infested trees and a buffer strip of nearby pines that might harbor incipient infestations.

Infested green timber, if promptly felled, can be used for certain timber products. These remedial tactics prevent damage to nearby residual trees but are not preventative and do little for area-wide population control.

Compounding the environmental and economic problems are the infestations of SPB in high value stands such as those in parks, homesites or critical wildlife habitats. Here, the removal of even a few beetle-infested trees can have severe aesthetic, economic, or biological implications.

Endangered species, such as the red-cockaded woodpecker, often can be critically impacted by loss of colony nests or foraging habitat. The use of pesticides in these situations often poses undesirable risks.

One of the most promising areas of bark beetle research currently being experimentally tested is the use of deterrent behavioral chemicals (semiochemicals) produced by the beetles themselves or by the host pine trees to disrupt or inhibit initial beetle attack or infestation growth. These biopesticides, used alone or in conjunction with silvicultural activities, are being investigated in collaborative research activities among LSU Agricultural Center scientists and those in the USDA Forest Service, Mississippi State University and the State of Florida.

The objectives of this research are to evaluate the biological potential of host-produced semiochemicals in preventing or deterring SPB attacks on high value pines and to develop rational methods for their development.

One semiochemical manufactured commercially and found naturally at low levels in the resin of certain plants (including pines) is 4-AA (chemical name = 4-allylanisole or estragole). This compound is repellent to many species of conifer-feeding bark beetles and is currently being investigated by the authors and others as a biopesticide capable of protecting southern pines from SPB attack.

In laboratory studies, more than 80 percent of the tested SPB, regardless of sex, were repelled by the presence of this semiochemical. In field studies using traps baited with a known beetle attractant, there was significant reduction in the number of SPB captured in traps where 4-AA was added. At the same time, natural enemies of the SPB, such as the predatory clerid beetle, were not affected.

In practical tests of 4-AA as a tree protectant, the material has been shown to be very effective. In one preliminary study, pine trees were treated with 4-AA within 48 hours of being struck by lightning. Ordinarily, these trees would be highly attractive to nearby beetles, and attacks would be capable of spreading to neighboring healthy pines.

Treatment consisted of using six small (20 ml) polyethylene vials per tree fitted with cotton wicks to allow the chemical to evaporate. The vials were attached at one meter intervals to a rope along the stem of the tree up to 5 meters.

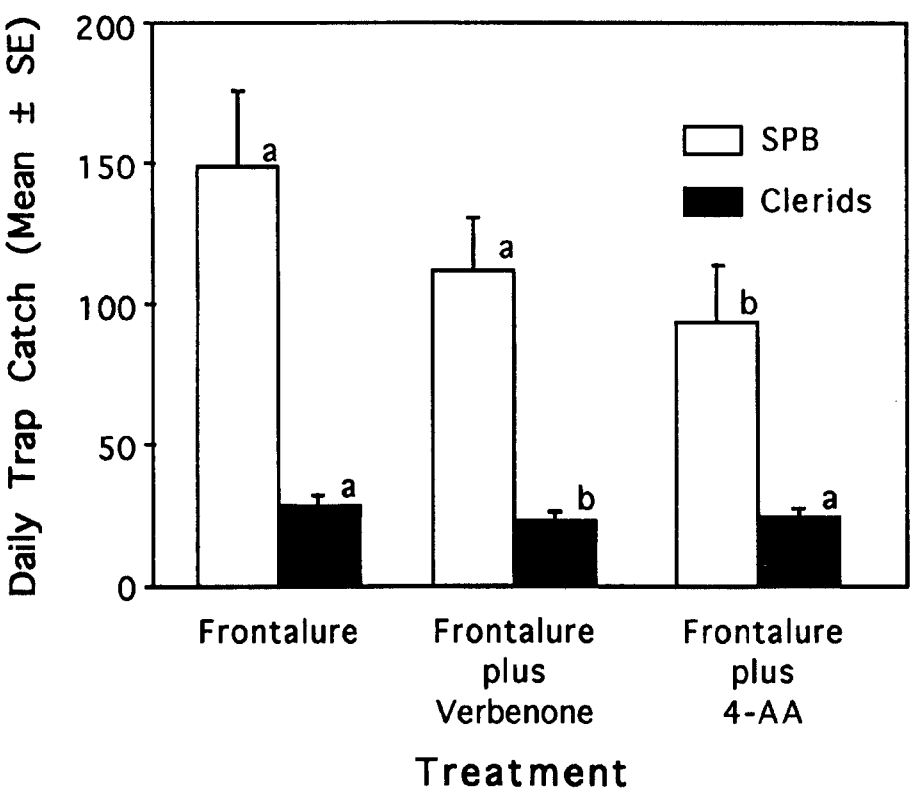
Trees in the vicinity struck by lightning during the same storm were located and served as untreated controls or checks. All treated trees were protected for the duration of the 30-day test while untreated trees were attacked by SPB and eventually killed.

Similarly, 4-AA is being further evaluated in natural pine forests as a protectant for cavity trees created and used by the endangered red-cockaded woodpecker. Protection of cavity trees and nearby "foraging" trees are critical to the survival of the woodpecker. These trees are often attacked by SPB because of the copious resin flow surrounding cavities.

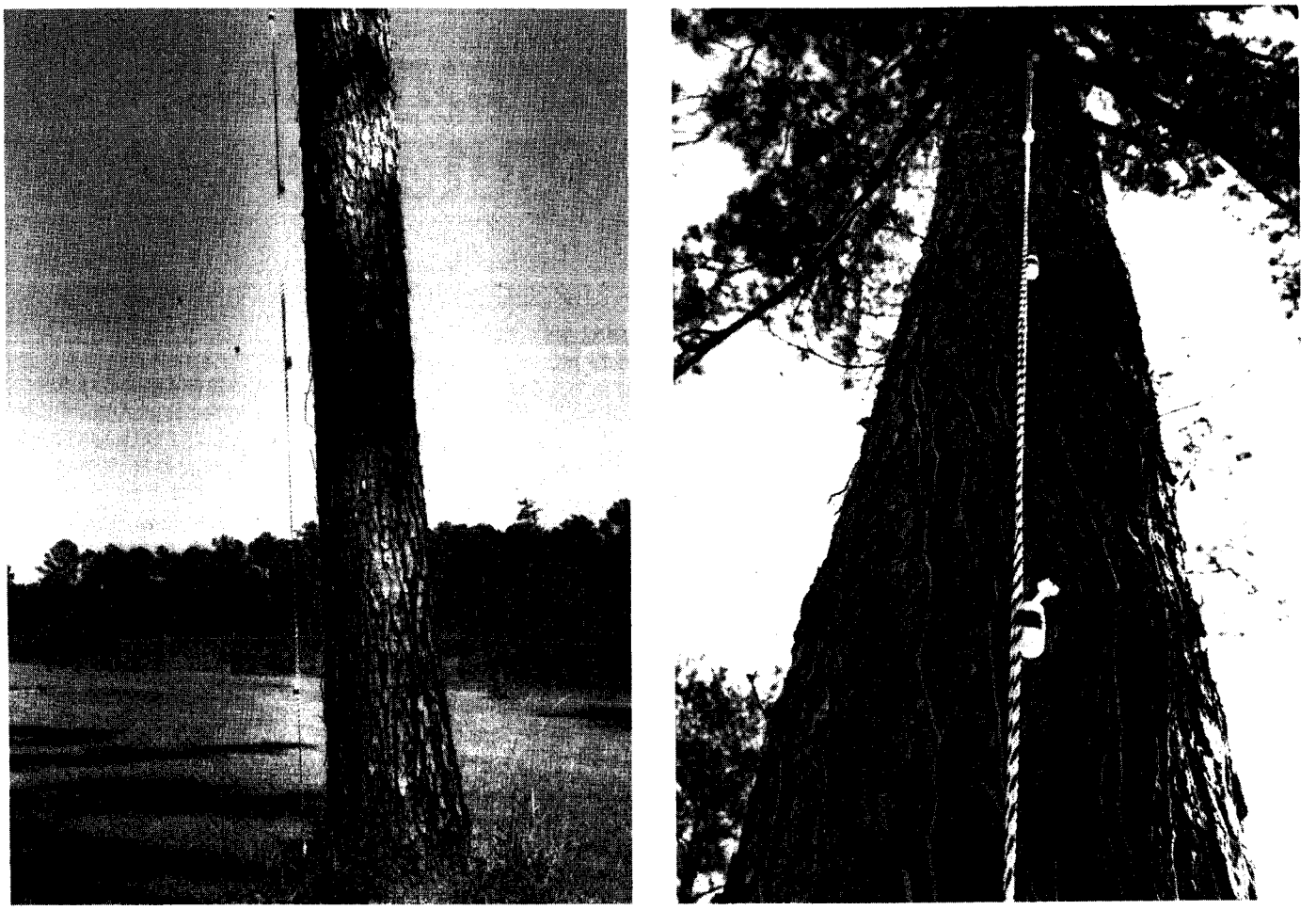
With the assistance of wildlife biologists, 4-AA is being evaluated on National Forest lands in Florida, Mississippi, and Louisiana. To date, none of the nearly 300 cavity trees treated with 4-AA ropes have been lost to SPB attack.

A recent outbreak of SPB in a residential area was used to evaluate the capability of 4-AA to protect high value pines. Here, individual trees have

Figure 1. Average daily capture of southern pine beetles (SPB) and a clerid predator in traps (two per treatment, six replicates) with the SPB attractant "frontalure" and two semiochemicals "verbenone" and "4-AA".



Note: Trapping was carried out (in the spring) in six active SPB infestations and trap positions rotated daily for six days. Bars with different letters are significantly different (based on ANOVA and LSD of transformed data).



"4-AA rope" utilized to protect high value pines from southern pine beetle attack.

considerable aesthetic value, but treatment or traditional removal of infested trees can be extremely costly and difficult to accomplish in a timely manner. Removal of a buffer strip of uninfested trees also is undesirable or not possible.

Along with traditional cutting and removal of infested trees and chemical insecticide treatments for tree protection, five homeowners allowed treatment of uninfested trees (73 trees) with 4-AA in vials along ropes as described earlier. Virtually all untreated trees in the vicinity of active SPB infestation were attacked. Only 8.2 percent of the 4-AA-treated trees (6 of 73) in yards were attacked, while large numbers of adjacent, untreated trees were attacked and killed.

A similar project is underway in St. Tammany Parish, where seven homeowners have cooperated in allowing treatment of 121 trees with a new gel-filled 4-AA dispenser attached directly to the bark. On-going studies will evaluate tree protection using these dispensers that eliminate the need for ropes and exposed vials.

This research, and additional studies underway at the LSU Agricultural Center, have demonstrated that a naturally occurring, tree-produced semiochemical has great promise in preventing attacks on small groups of high value pines. Further refinements, to aid practicability and to couple this unilateral approach with other techniques to disrupt beetle behavior, are being pursued in this collaborative state and federal research effort. ■

Table 1. Protection of pines from southern pine beetle at five homesites with 4-AA vials along ropes.

Homesite	No. treated	No. attacked	Adjacent Untreated Attacked
1	9	0	11
2	19	1	39
3	14	2	16
4	16	0	8
5	15	3	9
TOTAL	73	6 (8.2%)	83